

REMARKS

Claims 1-5 are pending in the present application. Claims 1-5 are rejected. Claims 1, 3 and 5 are herein amended. No new matter has been entered.

Objections to the Claims

Claim 4 is objected to because the claim reads “the tube has the size of the opening in the range of ...”, which is not idiomatic English phrasing. The Examiner notes that the phrase could be stated more clearly, such as -- an opening of the tube has a size range of...--, which would also use more appropriate articles for introducing new limitations.

Applicants so amend the claim.

Rejections under 35 U.S.C. §112

Claims 1-5 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite.

The Examiner asserts that in claims 1 or 5, the claimed process is unclear, because “when a metal oxide film is formed...” or when a second-tier eat...”, are not positively stated limitations.

Applicants herein amend claims 1 and 5 to positively recite the steps as follows:

1. (Currently Amended) A method for forming a metal oxide film ~~comprising,~~
comprising the steps of:

~~when forming~~ a metal oxide film ~~is formed~~ by conducting a thermal treatment on a coating film containing an organic metal compound formed on an inner wall of a tube, and performing
an ultraviolet irradiation treatment or
an ozone treatment
on the coating film prior to or simultaneously with the thermal treatment.

The Examiner further rejects claim 3, noting that while the alternative UV limitation from claim 1 is further defined, it has not been positively selected, hence effectively claim 3's limitation is not positively claimed, making whether or not it is intended to be required uncertain.

Applicants herein amend claim 3 to clarify the steps as follows:

3. (Currently Amended) The method for forming a metal oxide film of claim 1, wherein the step of performing an ultraviolet irradiation treatment is executed via further comprises the step of forming a mask of a predetermined pattern on the coating film.

Applicants submit that this amendment and language clearly narrow the claim scope of claim 1, and therefore comprise a properly limiting dependent claim.

Double Patenting

Claims 1-5 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-13 of U.S. Patent No. 6,932,664 B2.

The Examiner asserts that the conflicting claims are not patentably distinct from each other because while the claims of the cited reference are more detailed, they encompass the present claims, and the particularly claimed metal oxide species reads on the generic metal oxide.

The Examiner specifically notes that the step of “locally solidifying” is done to the solution as it forms the coating film, and the step of “burning the coating film to form an electron emission film on the entire inner wall of the tube” is claimed as being done to the entire film at once, implying that this thermal treatment is after the localized one, which may be done by drying or fixing by localized used of radiation, possibly UV radiation.

Applicants submit herewith a Terminal Disclaimer that disclaims any portion of any patent resulting from the present application that would extend beyond the expiration date of the cited reference.

Rejections under 35 U.S.C. §103(a)

Claims 1-5 are rejected under 35 U.S.C. §103(a) as being unpatentable over JP 59-13605 or Mizuta et al. (6,576,302 B1) or Chivukula et al. (6,337,032 B1) or Chandra et al. (5,935,638), in view of Celinska et al. (6,376,691 B1).

The Examiner asserts that all of the primary references teach deposition processes that correspond to one or the other of Applicant's alternative metal oxide deposition sequences. The Examiner admits that none of the cited primary references specify coating the interior of tubular substrates, however, the Examiner asserts that it is old and well-known in the metal oxide art to coat the interior of tubes, such as fluorescent lighting tubes with metal oxide compositions for

various purposes inclusive of electronic missive coatings and reflective coatings. The Examiner notes that Celinska et al. (abstract; column 2, lines 18 - 67; col. 3, line 1 - column 4, line 40) teaches that liquid organic metal (silicon) precursors of metal oxides and silicon oxides are coated on substrates such fluorescent lamp interiors, flat-panel displays and other electro-optical devices, where solid metal oxide films are formed in subsequent heating steps.

The Examiner concludes that it would have been obvious to employ any one of the deposition processes of the primary references to interiors of tubes, as Celinska et al. demonstrates that it is desirable to form such coatings on such substrates, with the primary references providing various formation advantages, especially that the techniques require lower heating temperatures to achieve similar or superior results to that formed by a purely thermal process.

Applicants disagree with the rejection with respect to Chivukula et al., because the reference does not appear to teach that which is asserted by the Examiner. Applicants note that Chivukula et al. appears to teach deposition of a solution containing metal organic compounds, drying of the film at low heat and then at higher heat, and then thermally annealed in oxidizing atmosphere, which may include ozone. However, the steps are in a different order from the claimed limitation of performing a UV or ozone treatment prior to or simultaneously with the thermal treatment.

With respect to the remaining rejections, Applicants herein amend the claims to clarify the invention. Thereafter, Applicants disagree with the rejections for the following reasons.

Applicants note that if the metal oxide film is formed by performing only the thermal treatment on the inner wall of a tube of the claimed invention, then the thickness of the metal oxide film becomes nonuniform by the following problems (i) to (iii);

- (i) Organic molecule emission from a tube, which is caused by decomposition of a coating film, is suppressed by internal pressure increase of a tube at the emission.
- (ii) It is difficult to supply oxygen necessary for decomposition and formation of a metal oxide film by the internal pressure increase, thus the formation of a metal oxide film takes a long time.
- (iii) Decreased viscosity due to heating of a coating film for a long time causes heat sagging of the coating film.

However, in the claimed invention, since the claimed prior treatments are performed prior to the thermal treatment, the above problems (i) to (iii) can be resolved.

Specifically, by performing the prior treatments prior to the thermal treatment, it is possible to decompose components contained in the coating film, convert the coating film to a film containing clustered metal oxide, and allow the metal oxide film to have a more uniform thickness than when the prior treatments are not performed (page 4, line 12 to page 5, line 4 of the English specification).

Applicants note that Nakagawa discloses a method for forming a metal oxide film on a glass substrate; Mizuta discloses a method for forming a metal oxide film on a quartz substrate;

Chivukula discloses a method for forming a metal oxide film on a semiconductor silicon substrate; and Chandra discloses a method for forming a metal oxide film on a silicon wafer.

However, none of the cited references discloses a method for forming a metal oxide film on an inner wall of a tube having a size of opening of not more than 2 mm, or a length of not less than 30 cm.

Applicants note that Celinska discloses a method for forming a conductive layer 44 comprising metal oxide material, on an envelope surface 42 in a lamp 10 (column 2, Figs. 1 and 2). As shown in Fig. 1, the tube that is one element of the lamp 10 is used for a fluorescent lamp, and it does not have such a characteristic shape as that of the tube of the claimed invention. One skilled in the art would not have made the modification of the method of Celinska to apply it to such a tube as claimed.

In view of the aforementioned amendments and accompanying remarks, Applicants submit that the claims, as herein amended, are in condition for allowance. Applicants request such action at an early date.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney to arrange for an interview to expedite the disposition of this case.

Application No. 10/642,271
Attorney Docket No. 030933

Amendment under 37 C.F.R. §1.111
Amendment filed: October 6, 2006

If this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees that may be due with respect to this paper may be charged to Deposit Account No. 50-2866.

Respectfully submitted,

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